ABSORBENT ARTICLE WITH AN ABSORBENT CORE DIVIDED BY INTERSECTING PASSAGES

CROSS-REFERENCE

[0001] This is the U.S. National Stage of PCT/JP 2004/003526, which was filed March 17, 2004 in Japan and which entered the U.S. National Stage in accordance with 35 U.S.C. 371, which, in turn, claims the benefit of priority of invention under 35 U.S.C. 119 based on JP 2003-71869, filed March 17, 2003, in Japan.

BACKGROUND OF THE INVENTION

1. The Field of the Invention

[0002] The present invention relates to an improved absorbent article such as a disposable diaper or a sanitary napkin, and more particularly to an absorbent article containing a flat absorbent core, in which the absorbent core is sandwiched between a liquid permeable front sheet and a liquid impermeable back sheet.

2. The Related Art

[0003] An absorbent article such as a disposable diaper or a sanitary napkin is basically composed of a flat absorbent core having excellent liquid absorbency, which is sandwiched between a liquid permeable front sheet and a liquid impermeable back sheet. In most conventional absorbent articles the flat absorbent core is bonded to both front and

back surface sheets with a hot melt adhesive in order to prevent the core part from slipping and shifting between the sheets.

[0004] However bonding the such an adhesion of an absorbent core and both sheets using a hot melt adhesive is not preferred because it impairs the absorbance of the core to some extent. Especially, when a hot melt adhesive is used to bond the front sheet with the absorbent core, a hardened adhesive is present between the front sheet and the absorbent core, which reduces the liquid permeability of the front sheet and the absorbency of the absorbent core.

[0005] An absorbent article is known from Unexamined Japanese Utility Model Application Publication No. H1-14707, in which a hot melt adhesive is not applied used between the flat absorbent core and the front or back sheet and in which the flat absorbent core is not displaced between the front and the back sheet. In this absorbent article the absorbent core is divided into parts and the periphery of each part is fixed firmly to the front sheet and the back sheet. In this absorbent article, since the periphery of the divided portions of the flat absorbent core is surrounded by the joint between the front sheet and the back sheet, deviation or slippage can be prevented without gluing the flat absorbent core and the above sheets with a hot melt adhesive. In addition to the above known article a conventional absorbent article is known from Unexamined Japanese Patent Application Publication No. H9-51913, in which an absorbent core is arranged between a liquid pervious front sheet and a liquid impervious back sheet and extends in the longitudinal direction of those sheets. A plurality of holes is provided that extend in the longitudinal direction and penetrate the absorbent core. The front and back sheets adhere along the holes in a non-removable manner so that the front sheet forms grooves extending along

the above holes. Furthermore, as another example, a disposable diaper is known from Unexamined Japanese Patent Application Publication No. 2002-165834 comprising an absorbent article composed of a liquid pervious front sheet, a liquid impervious back sheet, and an absorbent core which is arranged between these sheets. The absorbent core is covered with an absorbent diffusible sheet in such a manner that at least one depression or groove is provided on the front sheet side of the absorbent core, which extends in a direction from the front sheet to the back sheet so that a bottom part and a side wall part of the depressions or grooves are covered with the front sheet. In this absorbent article the absorbent core comprises absorbent fibers and super absorbent polymer particles, which are arranged between the front sheet and the back sheet on the bottom part of the depression.

[0006] In the conventional absorbent articles described above a groove or depression functions as a guide for liquid discharged on a front sheet. However, since an absorbent core adjacent to the groove or depression is under pressure from the front sheet, the inherent liquid absorbency of the absorbent core is disadvantageously decreased in proximity to the groove or depression.

[0007] That is, in a conventional absorbent article a groove or a depression is generally formed so that the front sheet sinks toward the back sheet side of the absorbent core to adhere thereto at each place at which the groove or depression is provided. Thereby, a flat absorbent core adjacent to the groove or depression is under pressure by the front sheet, which inconveniently causes the inherent absorbent capacity of the absorbent core to be impaired.

SUMMARY OF THE INVENTION

[0008] Thus it is an object of the present invention to provide a new absorbent article of the above-described kind, which comprises an absorbent core provided with at least one passage for distributing liquid discharged on the liquid permeable front sheet, and eliminating the above disadvantage of a conventional absorbent article, which has a groove or depression in its front sheet.

[0009] An absorbent article of the present invention comprises a rectangular or nearly rectangular shaped flat absorbent core arranged between a liquid permeable front sheet and a liquid impermeable back sheet. The flat absorbent core interposed between the two sheets is divided into not less than two parts to form at least one passage through the absorbent article. Each passage traverses a point within a circle, which has a radius of 25 mm and whose center coincides with the center of the absorbent article. Each passage has a depth equal to the thickness of the flat absorbent core and a width of from 2 – 6 mm. The front sheet, the back sheet, and the absorbent core are formed so that no groove or depression is observable in the front sheet or in the back sheet.

[0010] In contrast to the prior art absorbent article in which at least one groove or depression can generally be seen from the front side of the article, the absorbent article of the present invention does not have any observable grooves or depressions in its front side or back side. Instead in the absorbent article according to the invention internal passages through the absorbent core are provided to help distribute liquid passing through the permeable front sheet. Needless to say, both sidewalls of these internal passages are composed of the flat absorbent core and the liquid permeable front sheet and the liquid impermeable back sheet close the top and the bottom of the internal passages.

[0011] In preferred embodiments of the invention at least two intersecting passages are provided in the absorbent article, which divide the absorbent core into at least four separate parts. The at least two intersecting passages intersect at a common intersection point that is within a circle with a radius of 25 mm, whose center coincides with the center of the absorbent article.

[0012] In an especially preferred embodiment of the invention the absorbent core is divided into eight separate parts by three intersecting passages through the absorbent core, which extend between respective opposite sides of the absorbent article, or between opposite corners, or between opposite peripheral edges of the article. Each of the intersecting passages traverses a central intersection point within a circle with a radius of 25 mm, whose center coincides with the center of the absorbent article. In some embodiments the central intersection point is located at the center of the absorbent article.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The objects, features and advantages of the invention will now be illustrated in more detail with the aid of the following description of the preferred embodiments, with reference to the accompanying figures in which:

FIG. 1 is a partially plan, partially sectional view showing an example of an absorbent article in which a flat absorbent core is divided into two parts by a single central passage extending in the longitudinal direction from one side of the article to the opposite side;

FIG. 2 is a sectional view taken along the section line II-II of FIG. 1;

FIG. 3 is a partially plan, partially sectional view showing an example of an absorbent article in which a flat absorbent core is divided into three parts by two passages extending in the longitudinal direction between two sheets;

FIG. 4 is a sectional view taken along the line IV-IV of FIG. 3;

FIG. 5 is a partially plan, partially sectional view showing an example of an absorbent article, in which a flat absorbent core is divided into four parts by three through-going passages extending in the longitudinal direction between the front and back sheets;

FIG. 6 is a sectional view taken along the line VI-VI of FIG. 5;

FIG. 7 is a partially plan, partially sectional view showing another example of an absorbent article according to the invention, in which a flat absorbent core is divided by a plurality of through-going intersecting passages extending radially between the front and back sheets;

FIG. 8 is a partially plan, partially sectional view of a modified example of the absorbent article according to the invention shown in FIG.7; and

FIG. 9 is a vertical sectional view of a liquid injection pipe used in a circular diffusion experiment performed with saline solution.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] In this specification, disposable diapers and sanitary napkins are collectively called absorbent articles. However, there are many kinds of absorbent articles, such as articles with embossing or with cuffs and/or gathers with elastic materials that are provided in order to improve the fitting properties and leakage prevention. In addition, various suggestions have been made, for example, about the form and positioning of closures

provided on disposable diapers. However, such an absorbent article is basically composed of a rectangular or nearly rectangular shaped flat absorbent core interposed between a liquid pervious front sheet and a liquid impervious back sheet regardless of the kind of the article.

[0015] In this specification a nearly rectangular shaped flat absorbent core means a flat absorbent core, in which the four corners and/or crotch portions (coxitic part) of a rectangular shaped flat absorbent core are trimmed. Therefore, such a nearly rectangular shaped flat absorbent core includes an oval shaped absorbent core and an absorbent core whose plane form is guitar-shaped or hour glass-shaped.

[0016] Any liquid pervious sheet, liquid impervious sheet, or absorbent core used in manufacturing conventional absorbent articles can be employed for a front sheet, a back sheet, or an absorbent core of an absorbent article according to the present invention. The absorbent core is generally a laminated body or a flat shaped article composed of, for example, fluffed wooden pulp, super absorbent polymer, synthetic fibers, or the like. Most flat absorbent cores between the front and back sheets generally have the same thickness. However, the thickness of a central portion can be greater than that of a surrounding portion.

[0017] The most distinctive feature of the absorbent article of the present invention is that a rectangular or nearly rectangular shaped flat absorbent core arranged between a front sheet and a back sheet is divided into not less than two parts by at least one through-going passage traversing one point within a circle with a radius of 25 mm from its center (hereinafter so called as “a center circle”) to the periphery of the flat absorbent article. This

passage is 2 – 6 mm in width while the passage is hidden so that it can be directly seen neither from the front side nor the back side.

[0018] When a gap or passage dividing a flat absorbent core into not less than two parts extends in two directions from one point within the aforementioned center circle, the two directions are typically opposite from each other. However, the directions do not need to be exactly opposite. In other words, each gap or passage dividing the flat absorbent core may, for instance, bend within the center circle. The flat absorbent core of the invention can be divided into a plurality of parts by more than one hidden passage extending radially from one point within the center circle to the periphery of the absorbent core.

[0019] FIGs. 1 - 8 depict various embodiments of absorbent articles of the invention, wherein the flat absorbent core is divided or partitioned into a plurality of parts by one or more than two hidden passages and the absorbent core is interposed between a liquid permeable front sheet and a liquid impermeable back sheet. In the illustrated absorbent articles the rectangular shaped absorbent core is embodied as a flat absorbent core that is divided or partitioned into parts by gaps or hidden passages. However, as explained previously, a nearly rectangular shaped absorbent core of which four corners and/or crotch portions are trimmed can replace the foregoing absorbent core. When a crotch portion of an absorbent core used in an absorbent article is trimmed so as to deform its plane figure into an hourglass shape or a guitar-shape, crotch portions of the corresponding front sheet and back sheet may be trimmed as well.

[0020] FIGs. 1 - 8 show examples in which the form of both front sheet and back sheet is also rectangular, similar to that of the flat absorbent core. This does not imply that a front sheet and a back sheet of an actual absorbent article are actually rectangular.

Incidentally, in disposable diapers, in case that a rectangular or nearly rectangular shaped flat absorbent core is used, the portions of a front sheet and a back sheet which surround the waist and the stomach when applied to the human body are generally extended in a wing shape. Therefore, in case of applying the present invention to a disposable diaper, this sort of a wing-shaped extension is provided on both front sheet and back sheet.

[0021] In addition, although it is not illustrated, according to the invention, it is possible to apply embossing finish on an absorbent article to improve fitting properties and leakage prevention when applied to the human body. Cuffs and/or gathers composed of elastic materials can be provided as well. Further, in a disposable diaper, various types of closures can be provided for fixing around the waist.

[0022] In the drawings, reference numeral 1 denotes a liquid pervious or permeable inner or front sheet, and reference numeral 2 denotes a liquid impervious or impermeable outer or back sheet, while reference numeral 3 denotes a flat absorbent core which is divided by a hidden passage 4 in the thickness direction.

[0023] In an absorbent article shown in FIG. 1, a rectangular shaped flat absorbent core is divided by a single passage extending in the longitudinal direction in the center and between the front and back sheets. FIG. 3 shows the absorbent article, in which a rectangular shaped flat absorbent core is divided by two passages arranged parallel to the center line extending in the longitudinal direction so that the center line is between them. FIG. 5 denotes an absorbent article, in which a rectangular shaped flat absorbent core is divided into four parts by three passages extending in the longitudinal direction.

[0024] In any absorbent article it is preferable for a passage extending in the longitudinal direction to traverse a circle C with a radius of 25 mm (a center circle), whose center is a

center of the flat absorbent core, but it is not necessary for each passage to be straight. For instance, in the absorbent core shown in FIG.5, since all three passages extending in the longitudinal direction must traverse the center circle C, the passage arranged at the center is typically straight while the other two passages arranged on both sides of the center one can have greater distance from each other at the edge of the center circle. In other words, each of the two passages arranged on both sides of the center passage may be angular, i.e. may bend within the center circle.

[0025] FIGs. 7 and 8 denote an absorbent article, in which a rectangular shaped flat absorbent core is divided into a plurality of parts by more than one hidden passage extending radially from one point P within a center circle C to the periphery of a flat absorbent core, particularly to an edge or corner of the article. In the absorbent article shown in FIG. 7, the starting point of the passage extending radially is at the center of the rectangular shaped absorbent core or article. In this embodiment three passages, each of which extend from either opposite sides or opposite corners of the article, divide the absorbent core into eight separate parts. The embodiment shown in fig. 8 is generally similar to that shown in fig. 7. However, in FIG. 8, the starting point P of the passage extending radially is not at the center of the rectangular shaped flat absorbent core but is within the center circle C, whose center is the center of the absorbent article or core. A circle depicted with a dotted line indicates the aforementioned center circle C with a radius of 25 mm.

[0026] In each of the illustrated absorbent articles a hidden passage 4 is bounded by sidewalls composed of the parts of the flat absorbent core and by the liquid pervious front sheet and liquid impervious back sheet arranged on the top and the bottom of the hidden

passage. Accordingly, the hidden passage 4 cannot be seen directly from either the front sheet side or back sheet side of the absorbent article.

EXAMPLES

[0027] The present invention is explained herein below more concretely by means of some examples. However the examples are not intended to limit the claims appended herein below.

Example 1

[0028] A five-layer absorbent core containing 47.1 % by weight of NBSK fiber, 4.3 percent by weight of thermally bonded fiber, and 48.6 percent by weight of super absorbent polymer was prepared with air laid equipment.

1^{St} Layer: NBKP fiber 55 g/m^2 + Thermally bonded fiber 5 g/m^2 = 60 g/m^2
2^{nd} Layer: Super absorbent polymer 85 g/m^2 = 85 g/m^2
3^{rd} Layer: NBKP fiber 55 g/m^2 + Thermally bonded fiber g/m^2 = 60 g/m^2
4^{th} Layer: Super absorbent polymer 85 g/m^2 = 85 g/m^2
5^{th} Layer: NBKP fiber 55 g/m^2 + Thermally bonded fiber 5 g/m^2 = 60 g/m^2

Total: 350 g/m^2

[0029] A 36 cm X 15 cm flat absorbent core was cut off from the thus obtained absorbent core sheet, divided into two parts by a 6 mm wide gap along the center line in the longitudinal direction. A 20 g/m^2 basis weight of Asahikasei Erutasu Aqua was applied onto a front sheet and a 25 μ thick PE film was applied onto a back sheet. The absorbent core, the front sheet, and the back sheet were assembled as shown in FIG. 1 to obtain an absorbent article as shown in FIG. 1.

Example 2

[0030] The procedure of example 1 was repeated to obtain an absorbent article as shown in FIG. 1, except for changing the width of the passage to 4 mm.

Example 3

[0031] The procedure of example 1 was repeated to obtain an absorbent article as shown in FIG. 1, except for changing the width of the passage to 2 mm.

Example 4

[0032] An absorbent article as shown in FIG. 3 was obtained by using the same size flat absorbent core and the same front sheet and back sheet as in example 1. In this article each of the two passages was 6 mm wide and a strip-shaped absorbent core between those passages was 25 mm wide.

Example 5

[0033] The procedure of example 4 was repeated to obtain an absorbent article as shown in FIG. 3, except for changing the width of the passages to 4 mm.

Example 6

[0034] The procedure of example 4 was repeated to obtain an absorbent article as shown in FIG. 3, except for changing the width of the passages to 2 mm.

Example 7

[0035] An absorbent article shown in FIG. 5 was obtained by using the same size flat absorbent core and the same front sheet and back sheet as in example 1. In this article each of three passages, which extend longitudinally between opposite sides of the flat absorbent core, was 6 mm wide. One of those passages was arranged along the center

line of the flat absorbent core in the longitudinal direction. The width of each of two strip-like absorbent core parts on opposite sides of this center passage was 17 mm.

Example 8

[0036] The procedure of example 7 was repeated to obtain an absorbent article as shown in FIG. 5, except for changing the width of the passages to 4 mm.

Example 9

[0037] The procedure of example 7 was repeated to obtain an absorbent article as shown in FIG. 5, except for changing the width of the passages to 2 mm.

Example 10

[0038] An absorbent article shown in FIG. 7 was obtained by using the same size flat absorbent core and the same front sheet and back sheet as in example 1. In this article the flat absorbent core was divided into eight parts by passages of 6 mm in width extending radially from the center of the flat absorbent core between a front sheet and a back sheet.

Example 11

[0039] The procedure of example 10 was repeated to obtain an absorbent article as shown in FIG. 7, except for changing the width of the passages extending radially from the center to 4 mm.

Example 12

[0040] The procedure of example 10 was repeated to obtain an absorbent article as shown in FIG. 7, except for changing the width of the passages extending radially from the center to 2 mm. A liquid absorption rate, a wet back volume, and a diffusion area ratio were each measured for each absorbent article obtained in examples 1 to 12 according to the methods described in the following paragraphs.

[0041] The measured results are shown in Table 1. A comparison example in table 1 reveals the measured results for an absorbent article obtained by repeating example 1, except for not dividing the flat absorbent core with a passage.

Liquid Absorption Rate

[0042] A measuring apparatus was prepared in which an injection pipe having an internal diameter of 45 mm was vertically mounted on the central portion of an acrylic board with dimensions of 10 cm X 10 cm X 10 mm in which an opening of the same inner diameter as the injection pipe was provided in the central portion of the acrylic board. The measuring instrument was gently placed approximately on the center of a front sheet of an absorbent article that was placed on a plane surface. The acrylic board was placed in contact with the front sheet so that the injection pipe was vertically oriented above it. Then 200 ml of an 0.9 weight percent physiological saline solution was poured into the injection pipe from the top so as to reach a liquid level of about 50 mm. Three samples of the saline solution were prepared for each absorbent article. The times in seconds for absorption of each saline sample by the absorbent article were measured. The average absorption time was obtained from the measured times for each saline sample.

Wet Back Amount

[0043] After each of the samples that absorbed 200 ml of the physiological saline solution was allowed to stand for 10 minutes, 30 sheets of filter papers with dimensions of 100 mm X 100 mm (trade name: Advantech No.1140, manufactured by Toyo Filter Paper Inc.) were piled onto the central portion of the absorbent article sample, and left for 5 minutes while loading 10 kg of weight thereon. Then the increase of weight of the filter papers was measured as the wet back amount.

Diffusion Area Ratio

[0044] A small amount of blue dye was added into the 200 ml of physiological saline solution used for measuring a liquid absorption rate as explained above. After the samples absorbed the colored saline solution, the area on the flat absorbent core through which the colored saline solution diffused was measured so as to evaluate the ratio of the diffusion area to the whole area of the flat absorbent core (36 mm in length by 15 mm in width).

Table 1 **PROPERTIES OF EXAMPLES OF THE ABSORBENT ARTICLES OF THE INVENTION AND A COMPARISON EXAMPLE THAT IS NOT OF THE INVENTION**

Modeled Diaper	Comparison Example	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6
Division of Absorbent Ditch Width (mm)	Not divided	2 parts 6	2 parts 4	2 parts 2	3 parts 6	3 parts 4	3 parts 2
Absorption Speed (sec)	66 70 70 average 69	11 11 12 average 11	15 15 15 average 15	30 27 28 average 28	8 8 8 average 8	10 10 10 average 10	23 19 19 average 20
Wet Back Amount	9.3 9.8 10.6 average 9.9	0.9 1.1 1.3 average 1.1	0.6 0.4 0.5 average 0.5	0.8 1.0 1.3 average 1.4	0.9 0.7 0.6 average 0.7	0.4 0.4 0.6 average 0.5	0.5 0.8 1.7 average 1.3
Diffusion Area Ratio	53.3	72.9	77.9	69.0	80.4	85.0	75.6

Table 1 (con):

Modeled Diaper	Comparison Example	Example 7	Example 8	Example 9	Example 10	Example 11	Example 12
Division of Absorbent Ditch Width (mm)	Not divided	4 parts 6	4 parts 4	4 parts 2	Radially divided 6	Radially divided 4	Radially divided 2
Absorption Speed (sec)	66 70 70 average 69	5 5 6 average 6	9 9 7 average 8	17 19 19 average 18	5 4 5 average 5	7 6 6 average 6	12 12 14 average 13
Wet Back Amount	9.3 9.8 10.6 average 9.9	0.5 0.6 0.6 average 0.6	0.3 0.5 0.6 average 0.5	0.8 1.0 1.4 average 1.1	0.4 0.3 0.5 average 0.4	0.5 0.4 0.5 average 0.5	0.7 0.8 0.9 average 0.8
Diffusion Area Ratio	53.3	84.8	83.6	75.2	93.8	92.6	84.5

[0045] It will be appreciated that each absorbent article according to examples 1 to 12 has been greatly improved not only in liquid absorption rate but also in wet back amount compared with those of the comparison example in which the absorbent core is not divided by a hidden passage. The following experiments were carried out to determine the most effective position for the hidden passages in the absorbent article of the invention.

[0046] An absorbent article was prepared by repeating the procedure of example 1 using an identical flat absorbent core, inner surface, and outer surface, except for not being divided by a gap or passage (same as a comparison example 1 of table 1). A liquid injection pipe shown in FIG. 9 was vertically positioned above the center of the absorbent article placed on a plane surface. 200 ml of an 0.9 weight percent physiological saline solution was poured onto the absorbent article at a flow rate of 14 ml/sec while varying the vertical distance from the outlet of the injection pipe to the absorbent article so as to measure the time in seconds for the saline solution to spread from the place it dropped to a concentric circle having a predetermined radius.

[0047] An internal diameter D of a cylindrical tube that comprises the upper half of the liquid injection pipe (FIG. 9) was 48 mm, while a conical tube that comprises the lower half had a length of 100 mm, an upper internal diameter of 10 mm, and an internal diameter at the liquid outlet of 3 mm. Furthermore, in order to maintain the average liquid flow of 14 ml/sec during the experiments, a head H of saline solution in the injection pipe was set at 215 mm before the liquid began to flow.

[0048] Table 2 shows the experimental results for the spreading times for the samples of the saline solutions to spread from the place where they are dropped to a concentric circle

having a predetermined radius, which were measured for a drop of 5 mm and of 25 mm. According to the experimental results shown in Table 2, the diffusion time was approximately 1.5 second, even when the horizontal distance from the drop position to the plane center of the absorbent core was 25 mm, which is within a tolerance of an absorbent article. In addition, a liquid flow free surface of approximately 50 mm in diameter in which its center was the drop position was observed on the surface of the absorbent core when the liquid flowed out. Accordingly, it is apparent from the experimental results that liquid absorbency can be greatly improved by locating a hidden passage for dividing an absorbent core within a circle having a radius of 25 mm from a plane center of an absorbent core when an outlet for liquid is positioned at the plane center of the absorbent core.

Table 2 **SPREADING TIMES FOR SALINE SOLUTION ON THE COMPARISON EXAMPLE OF THE ABSORBENT ARTICLE**

Radius of Diffusion Circle Of Liquid	Distance from Liquid Outlet to Surface of Absorbent Article	
	Diffusion Time with Distance of 5 mm	Diffusion Time with Distance of 25 mm
10 mm	0.7 second	0.8 second
20 mm	1.2 second	1.0 second
30 mm	1.8 second	1.4 second
40 mm	2.7 second	2.1 second
50 mm	3.0 second	3.3 second

[0049] In an absorbent article of the invention, since a hidden passage dividing the flat absorbent core into a plurality of parts functions as a guide for liquid discharged onto the absorbent article, the liquid discharged approximately to the center of the absorbent article can be quickly guided to the periphery. Moreover, the front or back sheet is not pressed into the absorbent core, not even into a section of the core adjacent to the hidden

passage, which is commonly seen because of that in conventional absorbent articles, so that the absorbent core of the absorbent article of the present invention is allowed to utilize its entire absorption capacity.

[0050] According to the present invention liquid discharged to the surface can diffuse into the whole absorbent core with little wet back amount, which improves the absorbent efficiency of the base material that makes up the absorbent core. As a result, the amount of the base material for absorbing a given amount of body fluid can be reduced, so that the invention provides an improved absorbent article, such as a resource saving or waste saving disposable diaper or sanitary napkin.